
Space Weather Technical Forecast

Issued on Friday, 21 October 2022 at 13:22 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Minor geomagnetic storm Likely from fast wind on UTC day of Sunday 23 October. Possible Earth-directed CME, analysis in course.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has been Low, with frequent small C-class flares observed at GOES16. Background X-ray flux showed a gradual rise compared with recent days, but reverted to earlier lower levels into the UTC day of Friday. The largest flare of the period was a C5.9 flare at 20/1653UTC from Ex-AR3122 on the northwestern limb.

There are now up to four sunspot regions on the visible disc. The main occupants of the current front side were nearing centre-disc, with both AR3126 and AR3127 showing some recent proliferation of their intermediate spots and spreading tendencies as a Csi/Beta and Cri/Beta respectively. Some development also occurred in the southwestern quadrant, with this possibly a re-development of AR3125, but also a new region to its east, although both of these potential regions are currently small and simple.

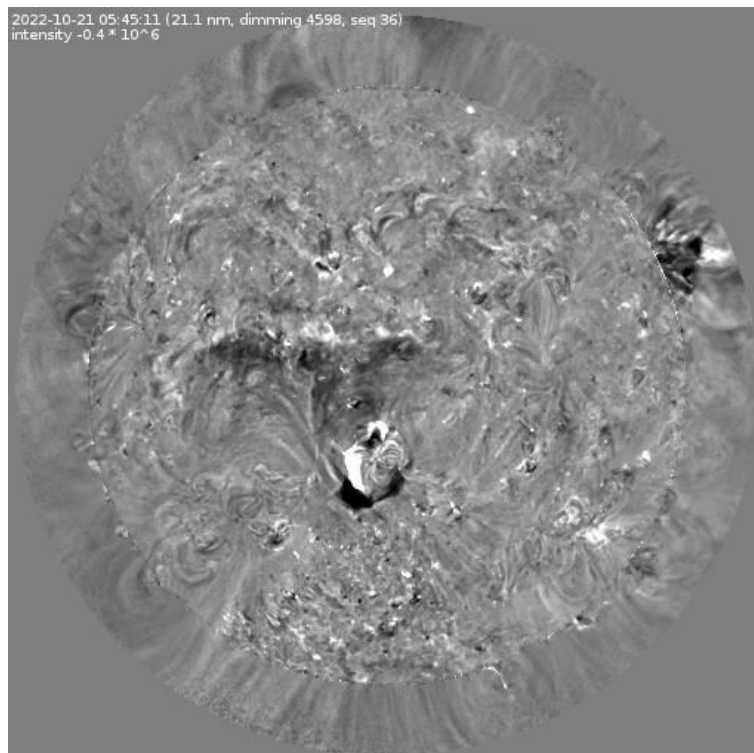


Figure 0: Time integrated AIA211 imagery of the aftermath of a centre-disc filament eruption. Analysis is pending. (Image processing courtesy of SIDC ROB)

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Starting at around 21/0415UTC, a possible filament eruption occurred to the immediate east of AR3126, with a subsequent dimming seen in AIA211 and 193 in the immediate aftermath, as well as a filament arcade structure marking the footprint of the event. Corresponding H-alpha imagery was less clear-cut, but the event is faintly visible on Learmonth observatory's images (for example). This potential CME-spawning event has yet to be analysed, with some early imagery from Lasco and STEREO perhaps suggesting at least a proportion of the release is angled above and ahead of the track of the Earth's orbit. This will be analysed as and when appropriate imagery becomes available. No other potentially Earth-directed Coronal Mass Ejections (CMEs) were in evidence.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, showed an exit from the long tail of a fast wind from CH32/- into a slow regime, with the phi angle mostly negative (towards the Sun), but with a late change to positive after 21/1100UTC.

The solar wind speed declined from Slightly Elevated levels to Background in falling from near-450km/s to 350. The solar wind density saw a slight rise in the same interval: from single-figures ppcc to around 10, while the IMF was near-level with a peak of 6nT. The north-south component of the field varied between +5 and -4nT, with an erratic tendency but also an overall drift from largely co-aligned (with Earth's field) to anti-aligned.

The net result of the above solar wind measures was for mainly Quiet geomagnetic activity, with isolated Unsettled peaks. The provisional peak Kp of 3o was recorded in the 12-15UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 has remained at Background levels.

High energy electron flux (greater than 2MeV) at GOES16 was mostly Moderate, but briefly reached High levels, with a peak flux of 1290pfu recorded at 20/1425UTC. The associated 24-hour integrated fluence was below the Active (1e8 integrated pfu) threshold on a generally flat trend, with 3.45e7 integrated pfu observed at 21/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to continue Low, with a daily Slight Chance of an isolated M-class flare. No notable regions leave or arrive on the disc in the period.

Solar Wind / Geomagnetic Activity: No CMEs feature in the current forecast, however the centre-disc dimming from 21/0415UTC has yet to be analysed.

The geomagnetic forecast is now in a state of flux. There is only one coronal hole in the forecast - the large and possibly south-polar connected CH34/-. A CIR leading this feature may now be in course at STEREO A, with the corollary that the onset of this coronal hole has been brought forward and its strength revised upwards.

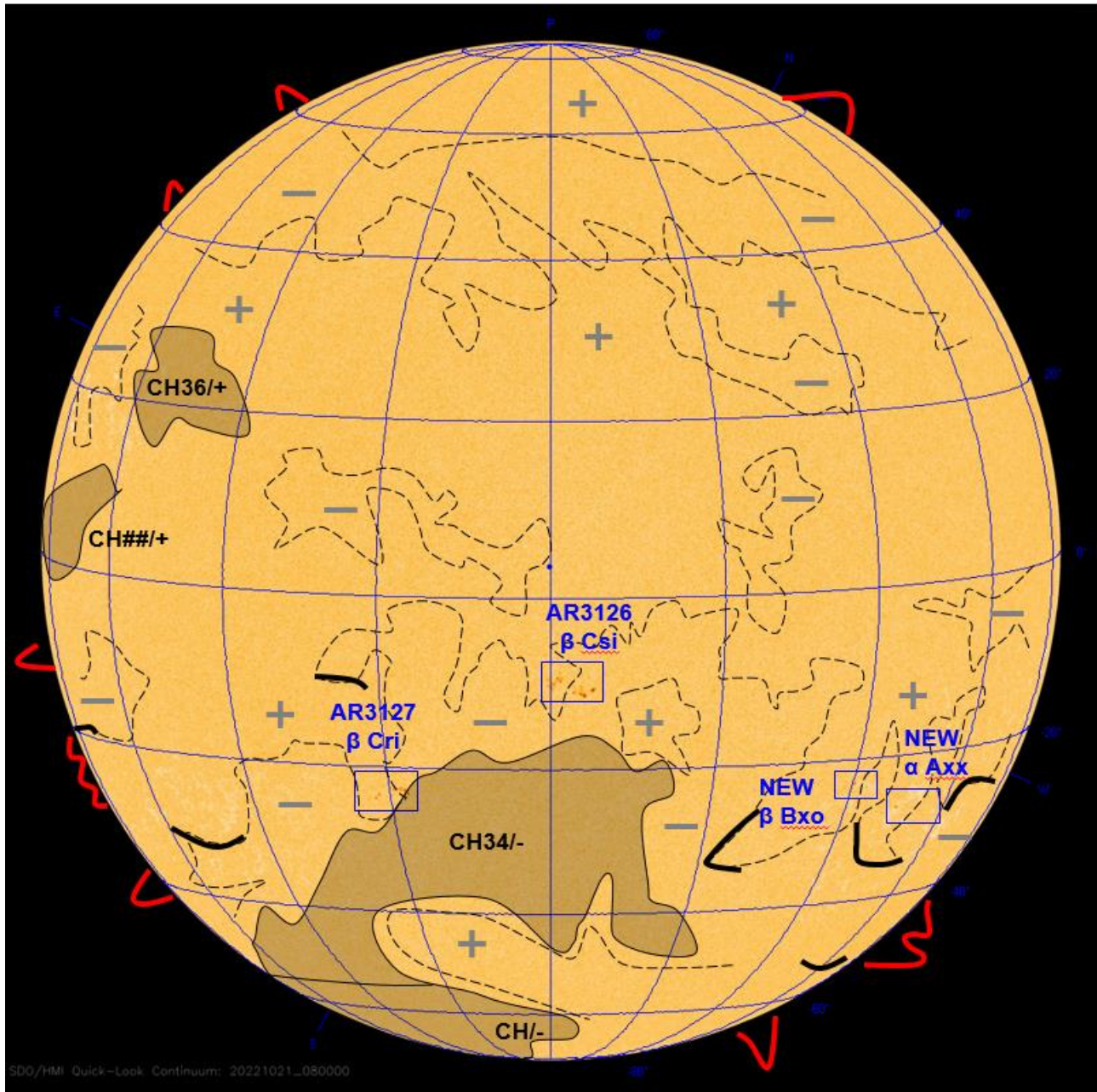
Initial Quiet geomagnetic conditions may increase to Active through day two (Saturday 22 October) in response to a marked CIR, with an ensuing Likely Minor Geomagnetic storm G1 Sunday 23 October, becoming a Slight Chance on day four.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at Background levels given the dearth of significant sunspot groups.

High energy electron flux (greater than 2MeV) as observed by GOES16 is expected to continue its current diurnal oscillation for the next 24-36 hours or so, possibly attenuating from the onset of the CIR on Saturday 22 October, and further still in the ensuing high speed stream from

CH34. There is a chance that fluence following CH34/- will respond sharply upwards, with a Chance of breaching Active on day four, Monday 24 October.

Figure 1. Solar Analysis Valid 21/0800UTC.



Key: Filament ___, Prominence ___, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No CMEs feature in the current forecast, however the centre-disc dimming from 21/0415UTC has yet to be analysed.

The geomagnetic forecast is now in a state of flux. There is only one coronal hole in the forecast - the large and possibly south-polar connected CH34/-. Initial Quiet conditions in the incumbent slow regime now look to be short-lived, with STEREO A MAG and PLASTIC measurements indicating a strong CIR has been in course here for around 12 hours. This feature appears to be the most significant event at STEREO A for the past month at least, with the density rising to a sizeable 250ppcc - with this due at Earth on Saturday morning UTC. The IMF has risen to 21nT, but fortunately co-aligned with Earth's field at +17nT at the time of writing.

Given STEREO is now less than 1.5 days upwind of Earth in the Parker spiral, it ought to be a good proxy for likely conditions here, and the onset time of CH34/- has been brought forward in the anticipation that the large IMF and density ought to soon be followed by the fast wind itself. MOSWOC Enlil is suggesting a 600km/s ought to be in course from around 24 hours' time, however this is felt to be too soon from the hole's visual position on the disc. Considering the above STEREO, Enlil and visual sources, a similar magnitude fast wind is now thought likely from day three, Sunday 22 October, in what would be a notable departure from persistence forecasts. This is the only coronal hole in the forecast.

All considered, initial Quiet geomagnetic conditions may increase to Active through day two (Saturday 22 October) in response to a marked CIR, with and ensuing Chance of a Minor Geomagnetic storm G1 Sunday 23 October, becoming a Slight Chance on day four. There is a Slight Chance (perhaps 10%) that G2 will be attained at peak on Sunday given the expected stronger hole on this rotation and the fact that an isolated Kp of 5+ was seen on last pass.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	10	60	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil, but note one unassessed candidate.

Figure 2: Latest MOSWOC Enlil run, showing forecast fast wind emanating from CH34/- as due later in the UTC day of Saturday 22 October. On balance, a later arrival time within the UTC day of Sunday 23 October is preferred, based on STEREO A, persistence and visual position on the disc.

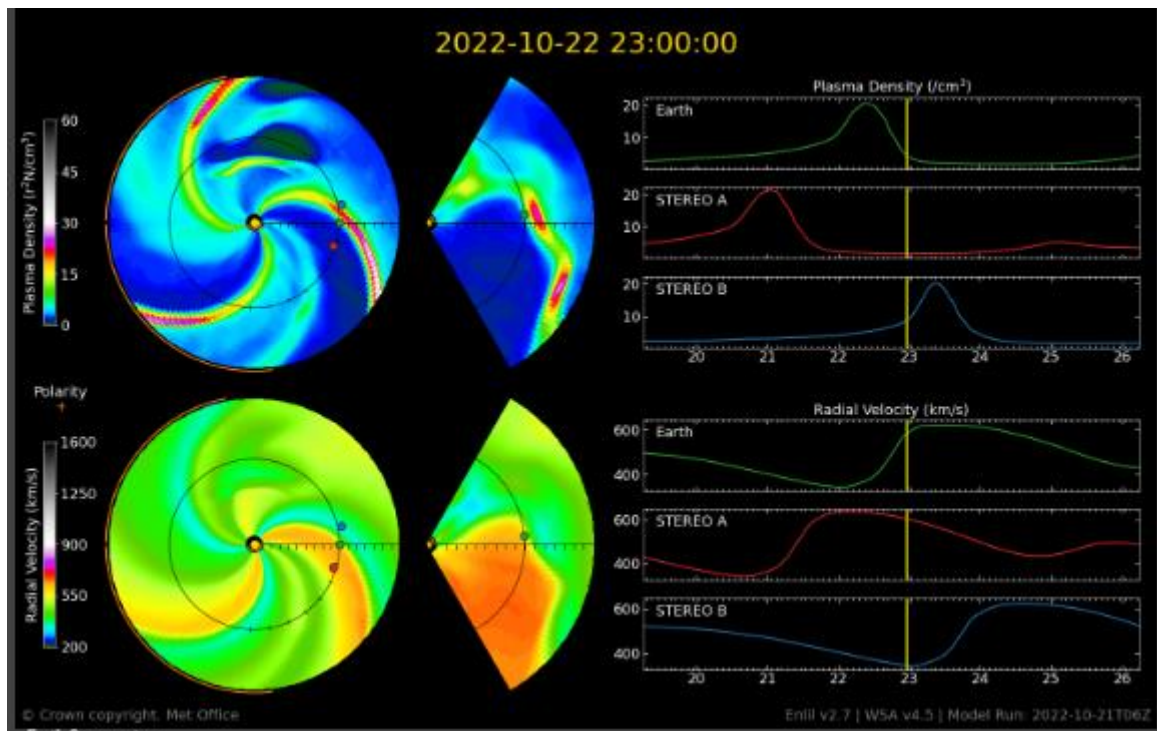
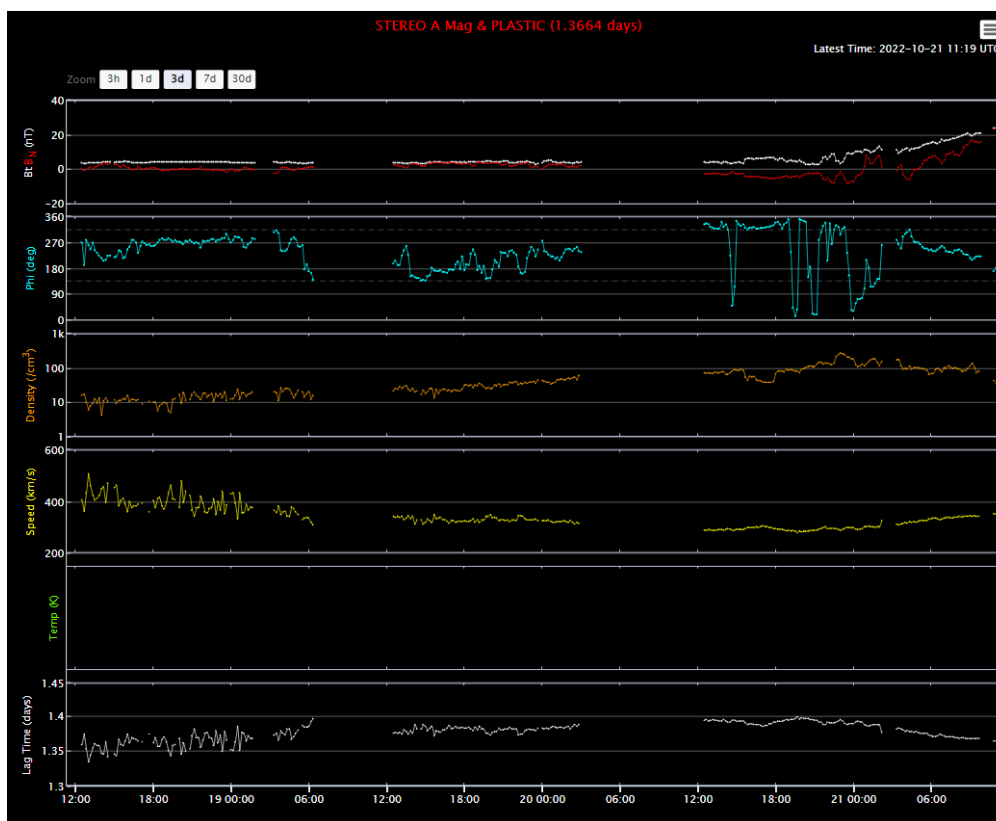


Figure 3: 3-day STEREO A MAG and PLASTIC measurements, showing a marked presumed CIR signature at the satellite.



Radio Blackouts - X-Ray Flares:

Solar activity over the past 24 hours has been Low, and is expected to remain so given the relatively spot-free Earth-facing disc. The most active region of the past 24 hours has now left the Earth-facing side (Ex-3122), and the daily Slight Chance of M-class flares has therefore been revised downwards slightly from the coming UTC weekend as it rotates away.

In terms of the balance of numbers on the front side, no significant regions depart in the four days, and while far-side soundings do suggest there may be some survivals near Ex-3111 and Ex-3115 later in the UTC weekend, any revision of risks upwards will wait until they present for analysis.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES16 is currently at Background levels and is expected to remain here given the lack of large sunspots in relevant locations on the disc.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) is expected to continue its current diurnal oscillation in near-enough its present form for the next 24 hours or so. There is an increasing chance of geomagnetic activity over the coming UTC weekend, with this likely to make itself felt in an apparent suppression of electron counts for a time, probably rebounding strongly into the new working week. The degree to which this occurs is relatively low confidence given the dissimilarity in strength and onset time of CH34/- compared to last pass, but this may occur as early as day four, Monday 24 October, with a Chance of breaching the Active threshold later in the UTC day.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	25
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	5